

# Determinants of Index Insurance Uptake

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Presentation at the FERDI organized  
workshop on

***“Microfinance products for weather risk  
management in developing countries: State  
of the arts and perspectives”***

Paris, June 25, 2014

# Plan of presentation

- An insurance demand model
- Factors affecting demand for WII
- Empirical ex-ante demand for Weather Index Insurance (WII)
- Ex-post demand for WII

**A theoretical model for the willingness to pay (WTP) or demand, for Weather Index Insurance (WII) by a farmer who insures in the first period of a year, and is compensated in the second period**

- Household WTP for insurance B can be written theoretically as follows

$$B = \delta E(rq) + \frac{1}{2} \rho \beta \left[ (\Delta R_{t_1})^2 - \delta \left( E(rq)^2 + 2E(rq\Delta R_{t_2}) \right) \right]$$

Where:

r is the return to the insurance contract per unit area insured

q is the amount of area insured

$R_{t_j}$   $j=1,2$ , denotes the value of resources available to the household at the beginning of period  $t_j$ , namely previous period assets plus current period income from these assets

$\Delta R$  is the deviation of current (ie in time  $t_j$ ) resources from expected, or long run values

$\beta$  denotes the amount of smoothing that the household does in each period. If  $\beta=0$ , then there is perfect smoothing. If  $\beta = 1$ , there is no smoothing at all, and current consumption moves exactly as current resources

$\rho$  is the coefficient of relative risk aversion

# Theoretical predictions

- First term is actuarially fair value of the insurance
- The larger is the degree of risk aversion (larger value of  $\rho$ ), and the smaller is the degree of consumption smoothing (larger values of  $\beta$ ), the larger is the benefit of or demand for insurance.
- The larger is the degree of (unpredictable) deviation of resources from normal (positive or negative), the larger is the WTP for insurance.
- The larger is the variance of the return of the insurance contract, the lower the WTP for it.
- The WTP for an insurance contract is larger with a more negative correlation between the return to insurance and the second period resource uncertainty.

# What determines uptake

- Uptake of insurance will then occur whenever these benefits are larger than the insurance premium, itself function of the cost of providing insurance (including assessment of damage, when needed) and of a loading factor  $m$ :
- $Uptake = 1$  if  $B \geq premium = cost (1 + m)$
- $= 0$  otherwise.
- From this, we see that there are six categories of determinants of uptake of an index-based insurance:
  - Quality of the insurance product/basis risk
  - Availability of other insurance mechanisms/risk layering
  - Expected gains from insurance
  - Lack of knowledge and trust/level of contracting
  - Learning from stochastic experiences
  - Cost of index insurance, price, and subsidies
- Among these, there are three determinants of uptake that are specific to index insurance relative to loss-based indemnity insurance:
  - Basis risk
  - Learning and understanding
  - Cost and price.

## Quality of the insurance product: Correlation between insurance payout ( $rq$ ) and shock on resources ( $\Delta R_{t2}$ )

- *Weather risk may not be the largest risk the farmer perceives and he may need more comprehensive insurance*
- Farmers are generally interested in income and wealth losses and not particularly about hedging rainfall shortages. This implies that a WII to be desirable has to correlate not only with the yield of one or more particular crop, but that these crops must be a significant share of the total income of the farmers.
- *Basis risk*
- In the above formulation basis risk can be thought of as the lack of negative correlation between the returns to the insurance  $z$  and the deviation of current resources  $R$  from trend.
- *Quality of contract design*

## **Ability to smooth consumption ( $\beta$ )**

- The farmer has other existing insurance mechanisms such as self-insurance, family, other social network, etc. In the model above this manifests itself in low magnitude of the consumption smoothing parameter  $\beta$ .

# Discount rate or credit constraint ( $\delta$ )

- *Insurance not desirable if not related to credit or other investment mechanism*
- *Lack of flexibility in terms of payment of premium or indemnity*
- *Time inconsistency ( $\delta$ ) combined with cash flow problems*

Credit gives a farmer the possibility of having resources now, with a promise to pay later. On the contrary, insurance implies a cash outflow now for an uncertain return later.



## Lack of knowledge/trust on distribution of payout and correlation with shocks

- *Lack of trust in the insurance provider*
- *Ambiguity aversion*

An ambiguity averse agent may not know the probability distribution of the insurance return  $r$  of the WII, and this is quite likely for a new product that has no known (to the agent) history of application. In such a setting the ambiguity averse agent will prefer to not take up the contract rather than purchase one that is not clear when and how it will compensate.

- *Technology and institutional setup are difficult to explain and understand*

## Learning from stochastic experiences

- *Recency bias: Demand depends on recent experiences*
- *Role of shocks (positive effect on the need for insurance) and role of payouts (negative effect of no payouts)*

# Cost and price

- A recognized advantage of index-based insurance is lower implementation costs compared to traditional loss adjustment-based insurance as it avoids the administrative costs of loss assessment and moral hazard, as well as the actuarial cost of adverse selection. Price however remains an issue for uptake. In spite of lower costs, prices may internalize a “data rent” as risks are initially poorly informed with existing data, translating into high insurance company loadings.

## **Estimation of ex-ante and ex-post Demand for Index Insurance in Ethiopia (EPIICA project 2011-14).**

- Used a Contingent Valuation technique, asking farmers whether they would be willing to purchase a specific insurance contract at prices that were randomized across survey respondents.
- Insurance was framed as covering the cost of inputs: fertilizers and improved seeds.
- Hypothetical insurance contract would pay 1000 birr per timad insured in 1 out of every 4 years, so actuarially fair price is 250 birr.
- Premiums used in the CV survey question were randomized to 50, 100, 150, 200, and 250 birr.
  - For those who DID want to purchase insurance, we then asked how many timad they would insure.

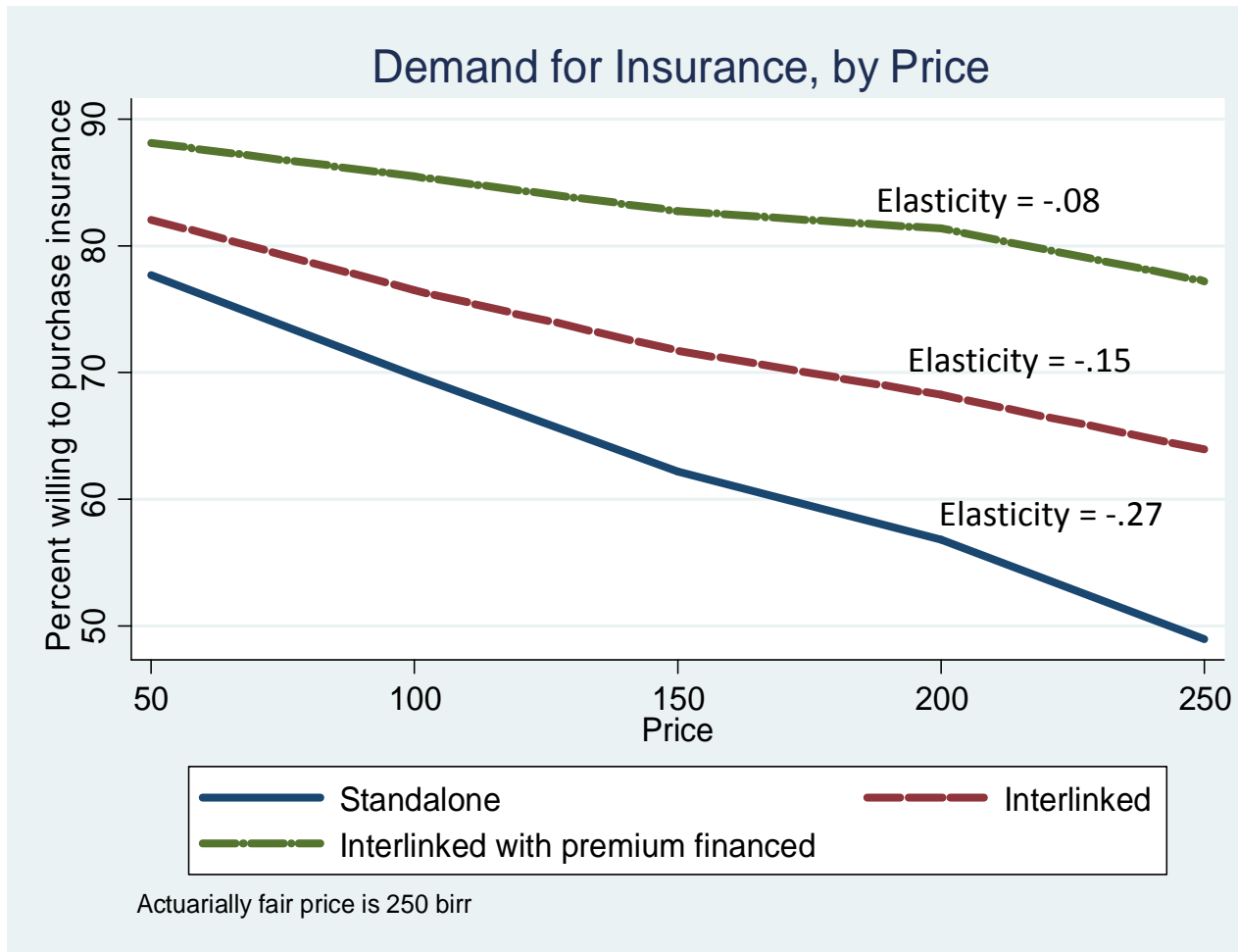
## Estimation of Interlinked Demand:

- For those who DID NOT want to purchase a standalone insurance contract (premiums paid in cash up front), we then asked the following:
  - Would you become interested in purchasing insurance now if you were to be able to receive the 1000 birr worth of inputs on credit rather than having to pay for them in cash up front? (basic interlinked product)
  - Would you become interested in purchasing insurance if both the inputs and the insurance premium were financed by credit? (full state-contingent loan).
- Comparison of these three questions lets us examine the stated willingness to pay for standalone insurance, as well as the additional demand created by interlinking.

**Estimates of the ex-ante WTP for weather index insurance  
(values for  $\pm \frac{1}{4}$  below or above normal rainfall or frost)**

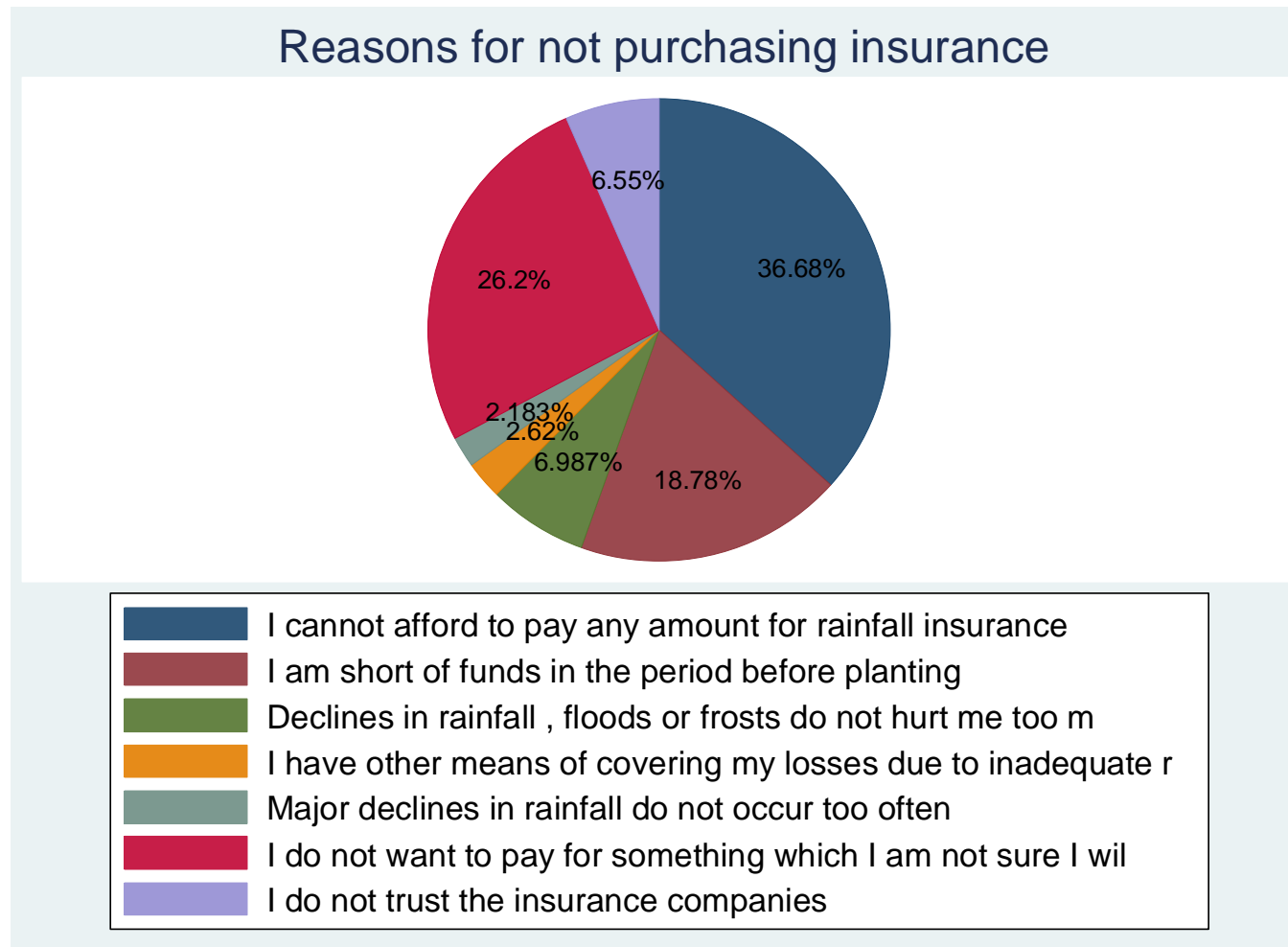
	Mean	Median	St. Dev	No of households with positive WTP*	Nr of households with negative WTP
WTP (birr)	276.7	284.2	76.5	1487	5

# Demand curves for each type of insurance:



Demand for the interlinked products is higher and less price elastic.

# Why do people *not* purchase standalone insurance?



Primarily lack of income, and insecurity about the product itself.



## Caveats:

- Field studies almost invariably find high STATED willingness to pay for index insurance, and then low REVEALED demand when people are asked actually to pay for it.
- So, probably shouldn't believe the absolute numbers on demand.
- Henceforth, we focus on ex-post variation in the uptake of WII

## **Uptake results first year (2012)**

49 villages in final study sample (out of 120)

34 treatment villages (17 standalone, 17 interlinked)

Sales achieved in 23 treatment villages (of 34)

Problems of information and Cooperative Union non-acceptance of interlinked loans

Each of 20 study households in treatment villages received a random voucher (five values 0-500 birr) for the insurance

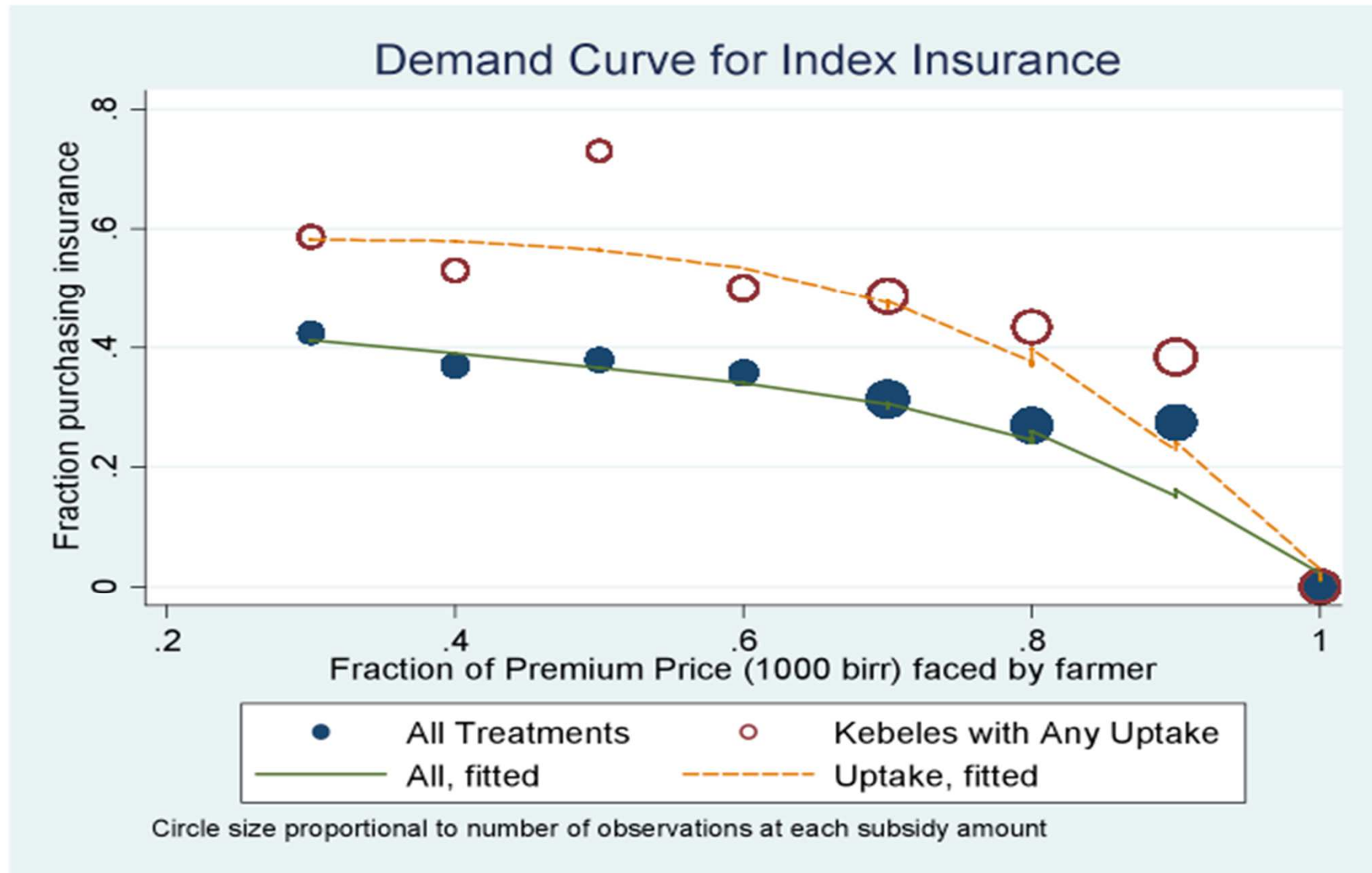
## Uptake results first year II

- Removed from the analysis all cooperatives in which not a single sale took place (reason, not sure whether constraints to adoption are on supply or demand side)
- Restricted study sample is 460 (20\*23). This sample turns out to be representative of entire drought prone sample of village households.
- 2012 campaign resulted in 202 policies sold (of which 170 within study sample). 25% of those we intended to treat. Within the kebeles that had any sales, the take-up rate in the study group rises to 37%.
- BUT: The take-up rate in the small studied sample that received no voucher is zero. Take-up rate among the roughly 4,000 cooperative farmers who were offered the insurance but did *not* participate in the study only 0.5%

## **Uptake results first year III**

- in general rather than using the voucher amount to cover a fraction of the cost of insuring all of their land, the farmers instead used the voucher to cover all of the cost of covering part of their land.
- Furthermore, among those who purchased WII only 42 (21 percent of those buying) paid an amount over and above the amount covered by the voucher, and of those only a little over one half (57 %) paid anything over 10 birr, which could arbitrarily be judged to be significant.
- Even among those who were given non-zero vouchers, the uptake rate was around 50 percent. In other words even if farmers were offered a “free good”, many chose not to take it.

# Demand for WII as a function of the fraction of premium price paid by farmer



## Regression of actual uptake on the ex-ante desirability of WII in baseline

Marginal effects probit with standard errors clustered at the kebele level.

	Purchased Insurance	Purchased Insurance	Purchased Insurance kebele fixed effects
Ex-ante WTP =yes	-0.0653	-0.0777*	-0.0176
	(0.039)	(0.040)	(0.040)
Received voucher		0.344***	0.375***
		(0.068)	(0.064)
Voucher amount		0.421**	0.392**
		(0.153)	(0.156)
Ex-ante WTP study randomized price		-0.278	-0.193
		(0.228)	(0.237)
Number of households	460	460	460

## Transformative versus palliative role of WII

- If risk is a driving constraint to the use of inputs, then we would expect to find those with high marginal products of land and particularly of capital to desire insurance. This relationship would suggest a **'transformative'** role for WII in relaxing constraints for those who currently underuse inputs.
- If those who do not use inputs have little demand for financial protection for input risk, then those with the highest demand are those with the highest use of inputs and thus the lowest marginal products. This would suggest a more **'palliative'** role for insurance; protecting those most exposed but not necessarily enabling an expansion of input use.

## Marginal products as determinants of WII demand

	Whole study sample in kebeles with any sales:		Interlinked villages only:	Among those purchasing insurance:	
	Stated Willingness to Pay	Purchased Insurance	Purchased Insurance in Interlinked Arm	Sum Insured	Amount of Own Cash used in Purchase
CV Price in WTP survey	-1.542*** (0.322)				
Received voucher		0.402*** (0.136)	0.644*** (0.195)	1,981*** (492.500)	-6.71 (9.007)
Voucher amount		0.339*** (0.051)	0.221*** (0.071)		
MP of Labor	0.000713*** (0.000)	-0.0000564 (0.000)	0.000258 (0.000)	2.137 (2.060)	0.0132 (0.029)
MP of Land	-8.19e-06*** (0.000)	-0.00000261 (0.000)	-0.00000851 (0.000)	-0.0434 (0.029)	-0.0000281 (0.000)
MP of Inputs	0.00809** (0.003)	-0.00547 (0.004)	-0.0221*** (0.005)	-30.91*** (10.540)	-1.050*** (0.383)
No of households	440	440	194	175	175

Robust linear probability model, Standard errors reported in parentheses.



**Demographic Determinants of WII uptake** (Marginal effects probit with  
standard errors clustered at the kebele level)  
(Dependent variable is a binary variable which is equal to 1 if the household  
bought WII and 0 otherwise)

		Purchased standalone insurance	Purchased interlinked insurance
Voucher amount	0.397** (0.152)	0.286 (0.239)	0.506** (0.209)
Any Voucher	0.380*** (0.070)	0.437*** (0.107)	0.273*** (0.079)
Insurance promotion at baseline	0.000526 (0.047)	0.0271 (0.075)	-0.0429 (0.055)
Age of HH Head	0.00118 (0.001)	0.000669 (0.002)	0.00274 (0.003)
HH Head Literate	0.026 (0.048)	0.0114 (0.075)	0.0255 (0.060)
HH Size (adult equivalents)	0.0122 (0.016)	0.026 (0.020)	-0.00716 (0.017)
Income per HH member	-2.08e-05* (0.000)	-0.0000254 (0.000)	-0.0000167 (0.000)
Number of large animals owned	-0.0147 (0.011)	-0.00974 (0.012)	-0.0294 (0.020)
Total area of land cultivated (hectares)	-0.0411 (0.049)	-0.084 (0.061)	0.0403 (0.048)
Area of land irrigated (hectares)	-0.0161 (0.138)	0.154 (0.135)	-0.0634 (0.094)
Chemical fertilizer used?	0.177** (0.065)	0.118 (0.093)	0.295*** (0.062)
Household is credit constrained	0.00595 (0.065)	0.112 (0.073)	-0.067 (0.091)
HH experienced drought in past 12 months	-0.0781 (0.093)	-0.0409 (0.127)	-0.0429 (0.098)
# of last 10 yrs in which shock experienced	-0.00659 (0.016)	-0.000965 (0.024)	-0.0168 (0.018)
Number of households	442	250	192
R-Squared	0.211	0.229	0.288

**Behavioral and Basis Risk Determinants of WII uptake** (Marginal effects  
probit with standard errors clustered at the kebele level)  
(Dependent variable is a binary variable which is equal to 1 if the household  
bought WII and 0 otherwise)

	<b>Behavioral Determinants</b>	<b>Basis Risk</b>
Voucher amount	0.371** (0.170)	0.399** (0.156)
Any voucher	0.360*** (0.072)	0.356*** (0.073)
Impatient	-0.119 (0.076)	
Hyperbolic	-0.0194 (0.072)	
Risk Averse	-0.00285 (0.064)	
Numerate	-0.00325 (0.051)	
Trusting	0.0411 (0.058)	
Trusts Financial Institutions	-0.0676* (0.033)	
Trusts the Cooperative	0.036 (0.033)	
Trusts District Government	0.0223 (0.050)	
Distance to nearest rainfall station (km)		0.00232 (0.009)
Elevation difference to nearest station (m)		0.000264 (0.000)
Distance to kebele center (km)		-0.00394 (0.027)
Elevation difference to kebele center (m)		-0.000653* (0.000)
Average distance from HH to plots (minutes)		0.00101 (0.001)
HH reports different rainfall from kebele		0.0179 (0.032)
Number of households	418	450
R-Squared	0.185	0.178

# Conclusions I EPIICA project

There seems to be unrealized potential for agricultural productivity growth in Ethiopia among smallholders

Among the factors that condition fertilizer use, risk factors as well as credit constrain factors are significant, supporting the underlying hypotheses of the effort to promote WII as a means to expand agricultural credit

The credit constraint hypothesis holds only partially. Perhaps because of the GOE system of providing guaranteed credit tied to fertilizer provision

Use of fertilizer reasonably high in two of the four zones.

Smallholders are quite inefficient in use of inputs. Excess labor and lower inputs and capital.

Credit constraints and risk factors affect the demand for inputs and inorganic fertilizer

Public supply and distribution for fertilizer system seems to be distorting markets

# Conclusions II EPIICA project

Promotion and subsidy will be necessary for a more widespread adoption of index insurance at the farmer level.

Slow process of building a WII market, and critical role played by marketing and outreach activities by the insurance company when this product is newly introduced

No evidence that stated WTP studies provide a useful picture of actual demand for index insurance products. But this could be due to implementation factors

Subsidy vouchers, even at very small cash amounts, are a very effective way of driving uptake for WII

High fertilizer use is a strong determinant of insurance uptake, the sum insured, and the amount of own cash that farmers put into buying insurance. This suggests that the product is likely to provide protection primarily to those who were already using inputs at high levels, rather than enabling a 'transformative' increase in input use among those who had not previously used them.

# Overall Conclusions

- Designing risk management products such as WII in developing country context is a challenging proposition but still has potential if marketed and organized properly. Very early to tell. Need more experience.

**Thank you**